SUMMARY OF A FALL TEST WITH PENETRATING OIL FOR CONTROL OF THE MOUNTAIN PINE BEETLE IN LODGEPOLE PINE - WASATCH NATIONAL FOREST, 1941.[1]

- - -

Introduction.--A test to determine the effectiveness of fall treatment with penetrating sprays to control the mountain pine beetle (Dendroctomus monticolae Hopk.) was made in the Iron Mine Unit on the Wasatch National Forest during the fall of 1940 by the Forest Service and reported upon by Mr. R. L. Furniss ("Summary of a Forest Service Administrative Test of Penetrating Oil Spray for Fall Treatment of the Mountain Pine Beetle - Wasatch National Forest, 1940", Office report Dec. 20, 1941). He found that while the treatment killed most of the brood, the mortality was not complete and that fall treatment with penetrating sprays could not be recommended until the results were known from additional tests. Accordingly, he outlined a test for the fall of 1941 which was again carried out by the Forest Service in the Iron Mine Unit. The results were sampled by Messrs. Clark Miles and Bruce Groves and the writer on June 26 and August 4. The purpose of this report is to summarize the work and present the results of the 1941 fall tests.

Treating Methods.--The procedure in treating the trees for the fall test was the conventional method used on the Forest for the spring and summer control work. The trees were felled, limbed, and bucked at the upper limits of the infested stem. The logs were sprayed from the top side and rolled to spray each successive sector. The stumps were sprayed without any preparatory treatment, such as hacking into the bark, to facilitate the penetration of the oil. The spray formula was 1 part by volume of orthodichlorobenzene to 4 parts by volume of diesel oil. Approximately 2½ gallons of the solution was used per tree. This is approximately one-half of a gallon more per tree than used for similar sized trees for the summer tests in 1942. Mr. Foote stated that more oil seemed necessary to penetrate the snow covered logs than is ordinarily required.

Treating Schedule.--The outline of the treating schedule provided for an early fall and late fall test, with each of these divided into two parts to provide a measure of the effectiveness of the method under favorable and unfavorable climatic conditions. Because of unavoidable delays the early

---

[1] The experiment was outlined by Mr. R. L. Furniss, Associate Entomologist, Forest Insect Laboratory, Bureau of Entomology and Plant Quarantine, Portland, Oregon. The selection of the infested trees and the treating was carried out during November and December, 1941, by the U. S. Forest Service under the direction of Mr. Grant L. Foote, Foreman in Charge, and Mr. Bruce Groves, Assistant Forester in Charge of insect control work on the Wasatch N.F. The results of treatment were checked upon by Messrs. Clark Miles, Bruce Groves, and N. D. Wygant during August 1942.

spray was not applied as early as desired. The treating schedule is summarized in the following table:

Time	Date	Climatic conditions	Number of trees	
			1941-attacks	Checks
Early fall	Nov. 1	Windy and snowing	10	2
" "	Nov. 3	Calm, partly cloudy	10	8
Late fall	Dec. 8	Clear	10	5
" "	Dec. 10	Calm, light snow	10	5
		Total	40	30

Climatic Conditions During Treating.--Notes taken on weather conditions by Mr. Grant L. Foote, Foreman in Charge, showed little difference in the weather conditions throughout the experiment. On November 1 and 3, approximately 6 inches of snow was on the ground and on December 8 and 10 approximately 36 inches of snow was on the ground. The temperature records taken by Mr. Foote during the experiment are briefly summarized in the following table:

Date	Maximum temp. °F.	Early morning temperature °F.	Time	Weather conditions
Nov. 1	41	24	7:00 AM	Stormy, snow
3	34	25	7:00	Calm, partly cloudy
4	42	31	8:00	Cloudy, snowy
5	33	25	6:00	Clear
6	43.5	28.5	7:00	Partly cloudy
7	43	12	7:00	Clear
	Similar clear weather and temperatures prevailed through Nov. 14			
Dec. 8	42	8	7:00 AM	Calm, clear
9	45	5	7:00	Clear
10	40	18	7:00	Cloudy, intermittent snow
	Similar weather prevailed after Dec. 10			

Mr. Foote states in his notes that snow got into the nozzles of the sprayers clogging the orifices and causing considerable trouble throughout the experiment. Considerable snow stuck to the boles making it necessary to remove the snow before spraying. On December 8 and 10, when there was 36 inches of snow on the ground, it was necessary to shovel the snow from the path of the tree to be felled in order to treat the tree satisfactorily. From his notes it can be seen that the work was carried out under difficulties.

Stage of Brood.--The brood in most of the trees at the time of treatment was in the parent adult and egg stages and a small amount in the newly hatched larval stage. Normally the insect brood reaches the 1/4 to full grown larval stage before development stops in the fall. This retarded development apparently was due to colder than normal temperatures during the season of 1941. An attempt was made to select the better brood trees for the experimental treatment.

Size of Trees.--The diameter breast height of the trees used in the test varied from 12 to 30 inches. In common with most of the lodgepole on the Iron Mine unit the trees were large, thick-barked, and overmature. The thick bark usually extends to 4 or 5 feet up the bole, above that the bark is usually thinner.

Sampling of Results.--The technique to follow in checking the results of the spray was quite a problem and one which provoked considerable thought. The problem in this particular case was to determine whether the mortality was satisfactory in the treated trees. As much as it would be highly desirable to know the percent mortality, the time required to obtain a sufficient number of samples to arrive at an accurate estimate is great, because of the heterogenous distribution of the brood, spotty survival, differences in bark thickness, bark texture, etc. In view of this, a rather crude method of sampling was used, based principally upon a qualitative analysis of mortality rather than a quantitative analysis. The stem of each tree was examined at a number of places to determine whether mortality was complete or whether there was developing brood. The brood in nearly all of the trees at the time of treatment was in the parent adult, egg, and a very limited amount in the tiny larval stages. Because of the difficulty of arriving at a mortality estimate of the egg and tiny larval stages, observations were directed toward survival rather than mortality. When areas with survival were found, the bark was peeled from a considerable area to determine the extent of the bark area under which survival occurred.

An attempt was made to check the results on June 26, but after 13 trees were sampled, it was evident that the lethal action of the penetrating oil was still in progress. Development of the brood in some cases was retarded as compared to the brood in the check trees, and it could not be determined at that time the total effects of the spray.

A recheck of the 13 trees and a check on the remaining 47 trees was accomplished on August 4 by Messrs. Miles and Groves and the writer. On this date the brood in the check trees was, for the most part, in the mature larval and pupal stages.

Results.--The results of the tests on the four dates are summarized in the following table:

Date of spray	Number of trees with 100% mortality of brood	Small patches of living brood	Normal brood development	Unsatisfactory attack at time of treatment
Nov. 1	7	2 1/		1
Nov. 3	6	2		2
Dec. 8	4	4 1/		2
Dec. 10	5	3		2
Check			18 2/	2
Totals	22	11	18	9

1/ One of the trees contained a heavy living brood on one side of the tree and therefore the results are considered unsatisfactory in that particular tree.

2/ Four of the 18 trees contained a very light brood.

Of the 33 treated trees that contained adequate attack, no living brood could be found in 22; small patches of living brood (usually not covering an area greater than 1/4 square foot) were found on 9 trees, otherwise the mortality was complete; and on 2 trees a heavy living brood was found on approximately 1/4 the circumference of the stem and running the full length of the stem (in other parts of these trees the brood was dead).

The decision as to the results of the tests, based on the comparison of living brood in treated trees with that in the untreated check trees, was that mortality was satisfactory on 31 trees and unsatisfactory on 2. Of the 20 check trees, 12 contained heavy brood, 2 medium brood, 4 light brood, and 2 contained no brood (unsuccessful and light attacks).

The fall tests appeared to be quite successful, particularly in view of the lateness and the adverse conditions under which the tests were made. The survival of brood in small local patches of bark is believed to be due to unusually thick bark, the patch being missprayed, or possibly a light application of oil at that point. No explanation is offered for the lack of mortality on one sector of each of two trees. When the bark of the trees is wet, it is difficult to determine the sprayed portion from the unsprayed portion and it is possible that one side was left untreated. However, Mr. Foote and the treaters had had previous experience with this method of control and it should not be assumed that a sector of the two trees was not sprayed.

When survival of insects occurred in a treated tree, it usually was under the thick bark near the butt of the stem. Perhaps the efficiency could be increased by making an extra heavy application of the oil on the butt section, or by making a second application after the first application has soaked into the bark. This second application could be made before the log is rolled to spray the next sector. These are suggestions only and should be tested to determine whether a more complete kill can be obtained.

The penetrating oil was not effective against the insects in the stumps. Therefore, if penetrating oil is used for fall control it will be necessary to peel the stumps. Hacking into the bark on the stumps before spraying should increase penetration of the oil sufficiently to kill the brood. This method has been used with success on large thick-barked stumps during summer control.

Conclusions.--For the most part the fall treatment with penetrating oil was quite successful and with limitations probably can be recommended for regular fall control work. The limitations appear to be as follows:

(1) Penetrating oil as now used cannot be relied upon to kill the "last insect" in a tree; however, mortality approaches 100 percent and perhaps this is sufficient.

(2) The brood in the 1941 attacked trees was in the parent adult, egg, and tiny larval stages as compared to overwintering brood of 1/4 to full grown larvae in a normal year. While the penetrating oil probably is as effective against the more-advanced brood as the retarded brood, this should be definitely determined before the method is extensively used.

(3) The presence of snow on the ground interfered with the efficiency of the work in this preliminary test to such an extent that it is evident that control with penetrating oil will have to be limited to the early fall before heavy snowfall.

(4) While adverse weather conditions apparently does not decrease the lethal action of the penetrating oil, it does make thorough coverage of the bark difficult because of the similarity in appearance of water soaked bark to oil soaked bark.

(5) The stumps should be peeled or a test made to determine the effectiveness on increasing penetration of the oil by hacking into the bark with an axe.

(6) Since survival in the treated trees is more common in the butt of large, thick-barked trees, a test should be made to determine whether complete mortality can be obtained by making an extra application of the oil on the butt.

(7) Finally, it is advisable to try the oil on a small fall operation before a large operation is undertaken.